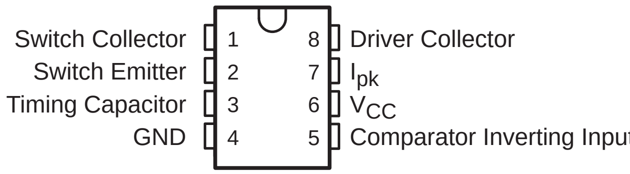
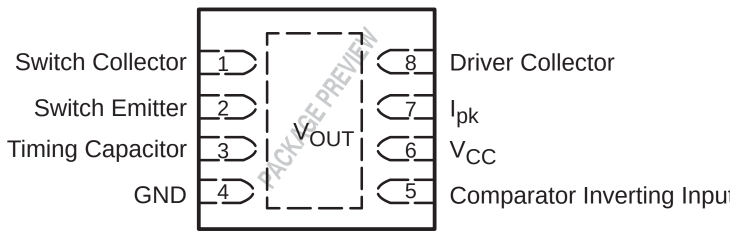
- **Wide Input Voltage Range . . . 3 V to 40 V**
- **High Output Switch Current . . . Up to 1.5 A**
- **Adjustable Output Voltage**
- **Oscillator Frequency . . . Up to 100 kHz**
- **Precision Internal Reference . . . 2%**
- **Short-Circuit Current Limiting**
- **Low Standby Current**

D (SOIC) OR P (PDIP) PACKAGE
(TOP VIEW)



DRJ (QFN) PACKAGE
(TOP VIEW)



description/ordering information

The MC33063A and MC34063A are easy-to-use ICs containing all the primary circuitry needed for building simple dc-dc converters. These devices primarily consist of an internal temperature-compensated reference, a comparator, an oscillator, a PWM controller with active current limiting, a driver, and a high-current output switch; thus, the devices require minimal external components to build converters in the boost, buck, and inverting topologies.

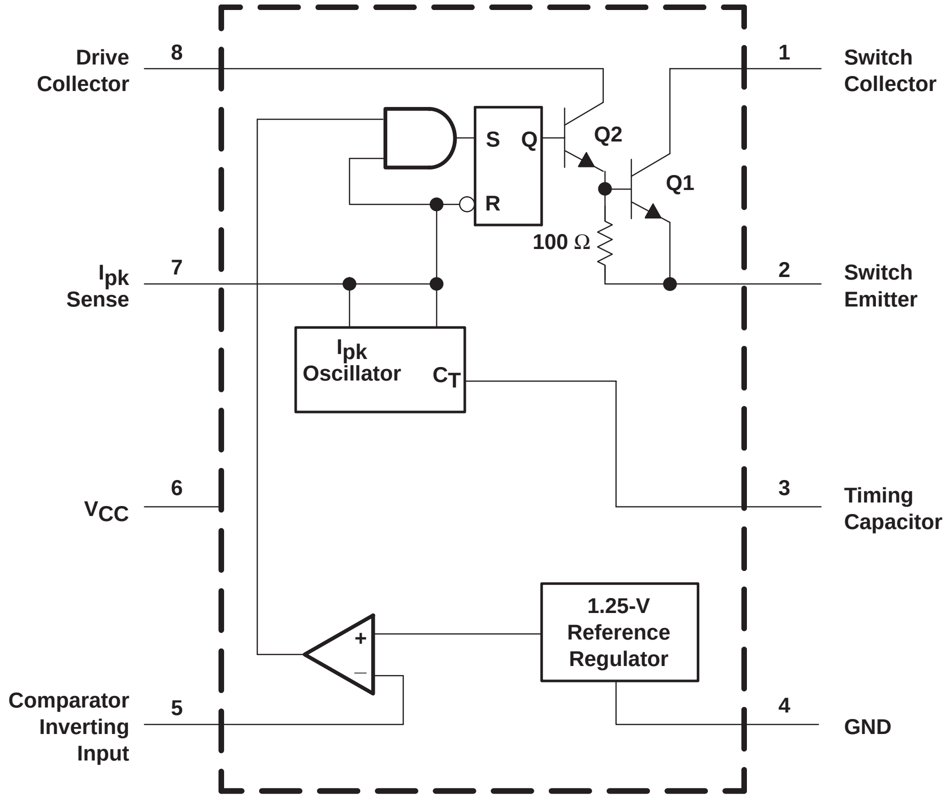
The MC33063A is characterized for operation from −40°C to 85°C, while the MC34063A is characterized for operation from 0°C to 70°C.

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
−40°C to 85°C	PDIP (P)	Tube of 50	MC33063AP	
	QFN (DRJ)	Reel of 1000	MC33063ADRJR	PREVIEW
	SOIC (D)	Tube of 75	MC33063AD	
		Reel of 2500	MC33063ADR	
0°C to 70°C	PDIP (P)	Tube of 50	MC34063AP	
	QFN (DRJ)	Reel of 1000	MC34063ADRJR	PREVIEW
	SOIC (D)	Tube of 75	MC34063AD	
		Reel of 2500	MC34063ADR	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

functional block diagram



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage, V_{CC}		40 V
Comparator Input Voltage Range, V_{IR}		−0.3 V to 40 V
Switch Collector Voltage, $V_{C(switch)}$		40V
Switch Emitter Voltage (V_{PIN1} = 40 V), $V_{E(switch)}$		40V
Switch Collector to Emitter Voltage, $V_{CE(switch)}$		40V
Driver Collector Voltage, $V_{C(driver)}$		40V
Driver Collector Current, $I_{C(driver)}$ (see Note 1)		100 mA
Switch Current, I_{SW} (see Note 1)		1.5 A
Package thermal impedance, θ_{JA} (see Notes 1 and 2):	D package	97°C/W
	DRJ package	TBD°C/W
	P package	85°C/W
Operating virtual junction temperature, T_J		150°C
Storage temperature range, T_{stg}		−65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. Maximum power dissipation is a function of T_J(max), θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.

2. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions

			MIN	MAX	UNIT
V_{CC}	Supply voltage		3	40	V
T_A	Operating free-air temperature range	MC33063A	−40	85	°C
		MC34063A	0	70	

electrical characteristics, V_{CC} = 5 V, T_A = full operating range (unless otherwise noted) (see block diagram)

OSCILLATOR

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
f_{osc}	Oscillator frequency	V_{PIN5} = 0 V, C_T = 1.0 nF	25°C	24	33	42	kHz
I_{chg}	Charge current	V_{CC} = 5 V to 40 V	25°C	24	35	42	µA
I_{dischg}	Discharge current	V_{CC} = 5 V to 40 V	25°C	140	220	260	µA
I_{dischg}/I_{chg}	Discharge to charge current ratio	V_{PIN7} = V_{CC}	25°C	5.2	6.5	7.5	
V_{Ipk}	Current limit sense voltage	I_{dischg} = I_{chg}	25°C	250	300	350	mV

OUTPUT SWITCH (see Note 3)

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
$V_{CE(sat)}$	Saturation voltage - Darlington connection	I_{SW} = 1.0 A, pins 1 and 8 connected	Full range		1.0	1.3	V
$V_{CE(sat)}$	Saturation voltage - Non-Darlington connection (see Note 4)	I_{SW} = 1.0 A, R_{PIN8} = 82 Ω to V_{CC}, forced β ∼ 20	Full range		0.45	0.7	V
h_{FE}	DC current gain	I_{SW} = 1.0 A, V_{CE} = 5.0 V	25°C	50	75		
$I_{C(off)}$	Collector off-state current	V_{CE} = 40 V	Full range		0.01	100	µA

NOTES: 3. Low duty-cycle pulse testing is used to maintain junction temperature as close to ambient temperature as possible.
4. In the non-Darlington configuration, if the output switch is driven into hard saturation at low switch currents (≤300 mA) and high driver currents (≥30 mA), it may take up to 2.0 µs for the switch to come out of saturation. This condition effectively shortens the off time at frequencies ≥30 kHz, becoming magnified as temperature increases. The following output drive condition is recommended in the non-Darlington configuration:

Forced β of output switch = $I_{C,SW}$ / ($I_{C,driver}$ − 7 mA) ≥ 10,
where ∼ 7 mA is required by the 100 Ω resistor in the emitter of the driver to forward bias the V_{be} of the switch.

COMPARATOR

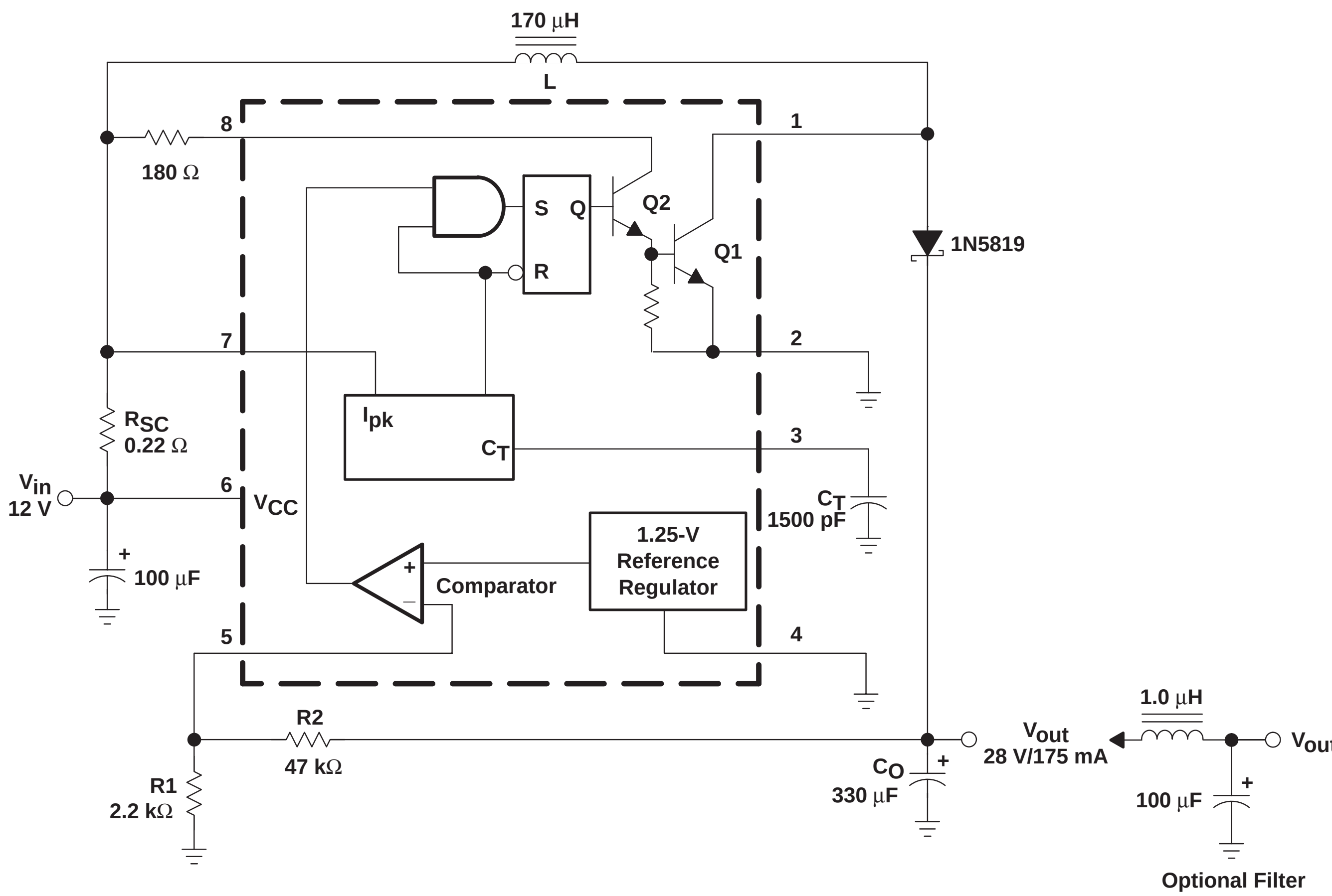
PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
V_{th}	Threshold voltage		25°C	1.225	1.25	1.275	V
			Full range	1.21		1.29	
ΔV_{th}	Threshold voltage line regulation	V_{CC} = 5 V to 40 V	Full range		1.4	5	mV
I_{IB}	Input bias current	V_{IN} = 0 V	Full range		−20	−400	nA

TOTAL DEVICE

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
I_{CC}	Supply current	V_{CC} = 5 V to 40 V, C_T = 1 nF, V_{PIN7} = V_{CC}, V_{PIN5} > V_{th}, V_{PIN2} = GND, all other pins open	Full range			4.0	mA

TYPICAL CHARACTERISTICS

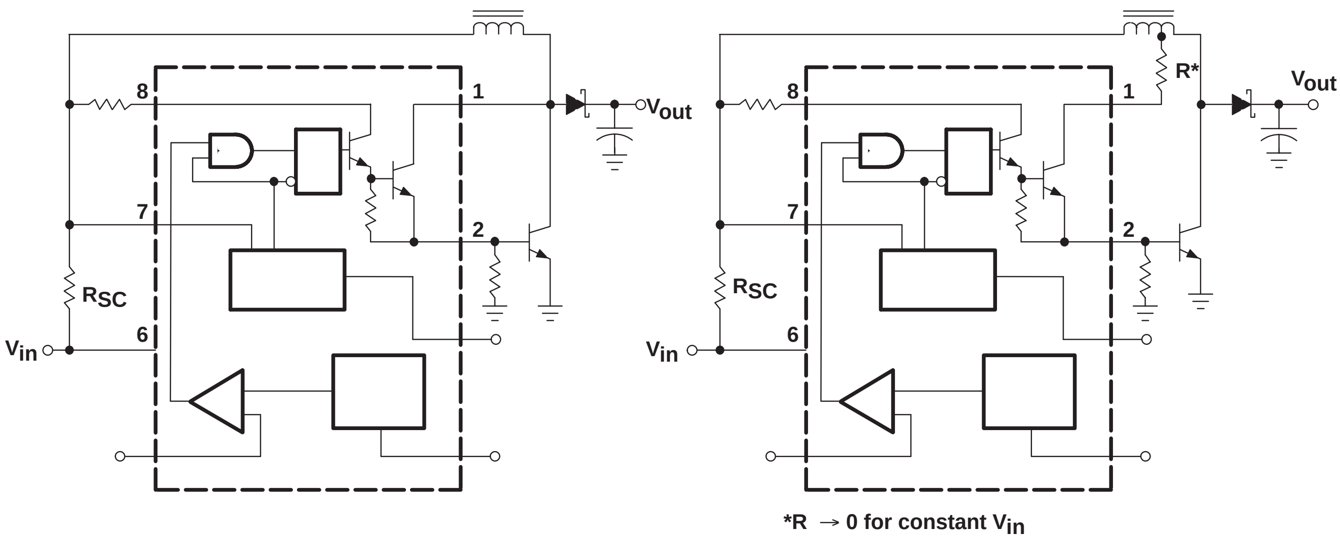
1. Output Switch On-Off Time vs. C_T (Timing Capacitor)
2. C_T (Timing Capacitor) Waveform
3. Emitter Follower Configuration: Output Saturation Voltage vs Emitter Current
4. Common Emitter Configuration: Output Saturation Voltage vs Collector Current
5. Current Limit Sense Voltage vs Temperature
6. Standby Supply Current vs Voltage Supply



TEST	CONDITIONS	RESULTS
Line Regulation	V_{IN} = 8 V to 16 V, I_O = 175 mA	30 mV = ±0.05%
Load Regulation	V_{IN} = 12 V, I_O = 75 mA to 175 mA	10 mV = ±0.017%
Output Ripple	V_{IN} = 12 V, I_O = 175 mA	400 mV_{PP}
Efficiency	V_{IN} = 12 V, I_O = 175 mA	87.7%
Output Ripple With Optional Filter	V_{IN} = 12 V, I_O = 175 mA	40 mV_{PP}

Figure 1. Step-Up Converter

TYPICAL CHARACTERISTICS



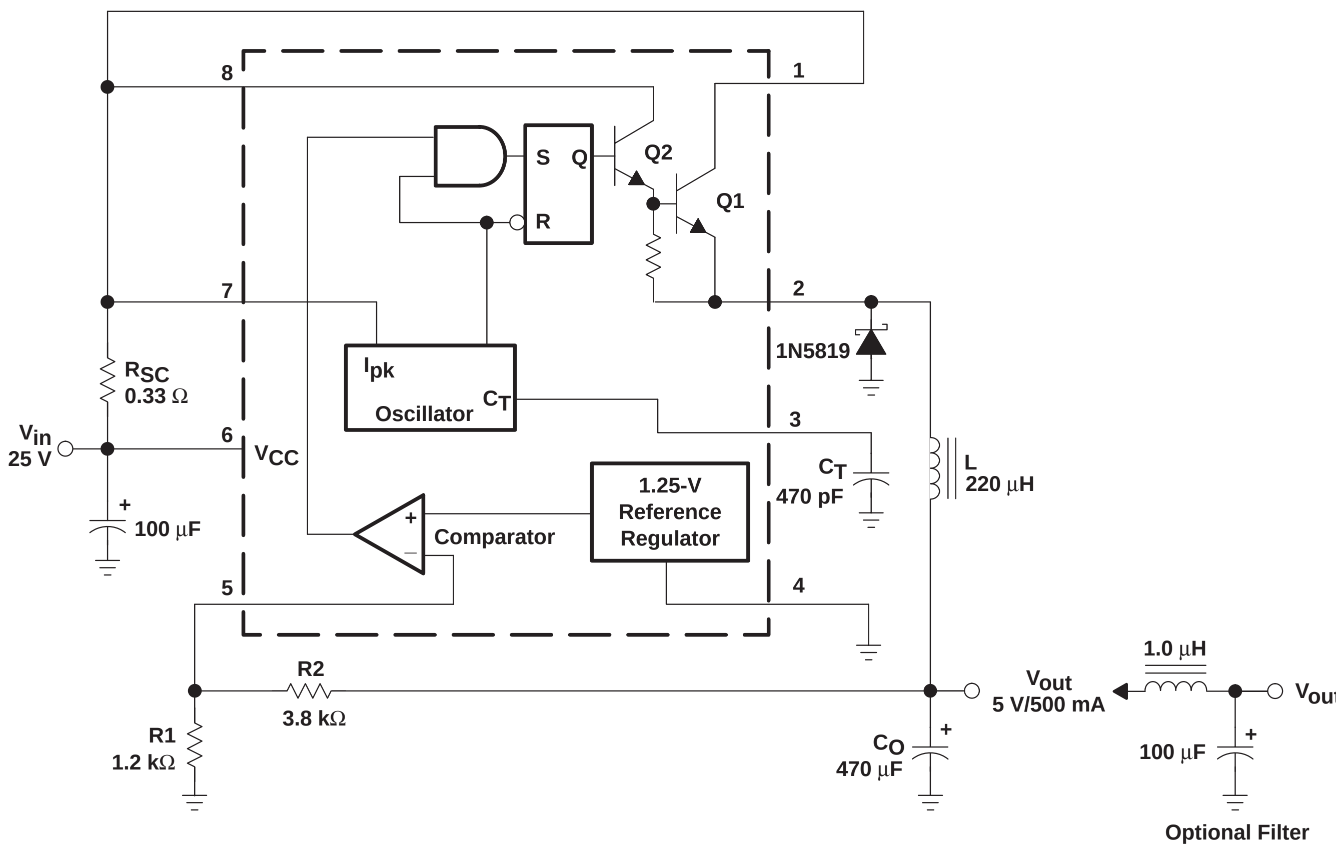
2a. External npn Switch

2b. External pnp Saturated Switch (see Note 5)

NOTE 5: If the output switch is driven into hard saturation (non-Darlington configuration) at low switch currents (≤300 mA) and high driver currents (≥30 mA), it may take up to 2.0 µs to come out of saturation. This condition will shorten the off time at frequencies ≥30 kHz, and is magnified at high temperatures. This condition does not occur with a Darlington configuration because the output switch cannot saturate. If a non-Darlington configuration is used, the output drive configuration in Figure 2b is recommended.

Figure 2. External Current Boost Connections for I_C Peak Greater than 1.5 A

TYPICAL CHARACTERISTICS



TEST	CONDITIONS	RESULTS
Line Regulation	V_{IN} = 15 V to 25 V, I_O = 500 mA	12 mV = ±0.12%
Load Regulation	V_{IN} = 25 V, I_O = 50 mA to 500 mA	3 mV = ±0.03%
Output Ripple	V_{IN} = 25 V, I_O = 500 mA	120 mV_{PP}
Short-Circuit Current	V_{IN} = 25 V, R_L = 0.1 Ω	1.1 A
Efficiency	V_{IN} = 25 V, I_O = 500 mA	83.7%
Output Ripple With Optional Filter	V_{IN} = 25 V, I_O = 500 mA	40 mV_{PP}

Figure 3. Step-Down Converter

TYPICAL CHARACTERISTICS

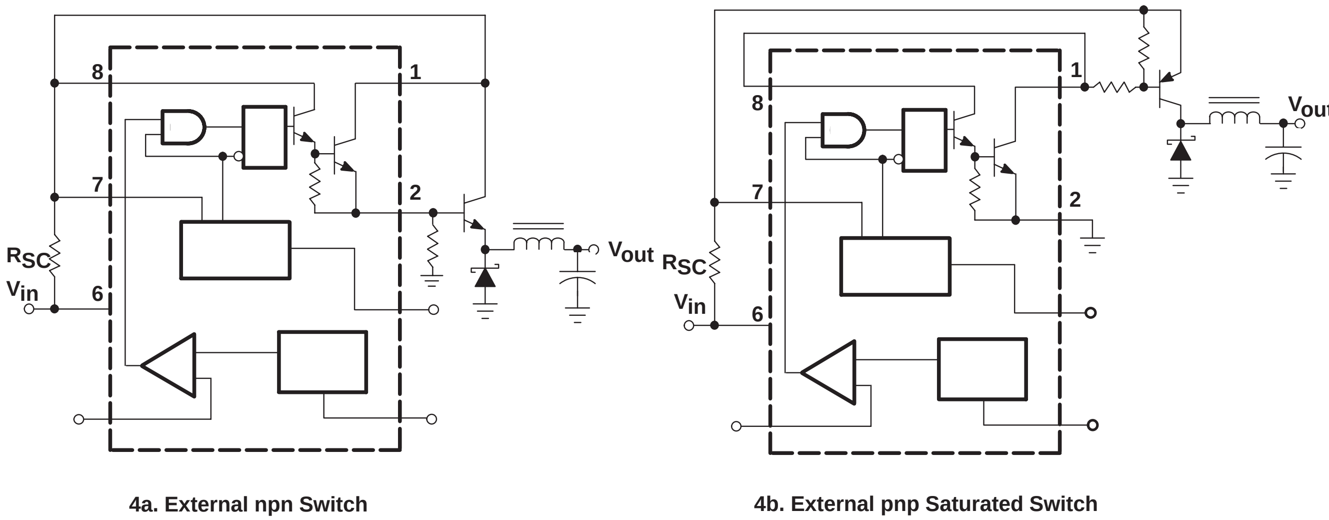
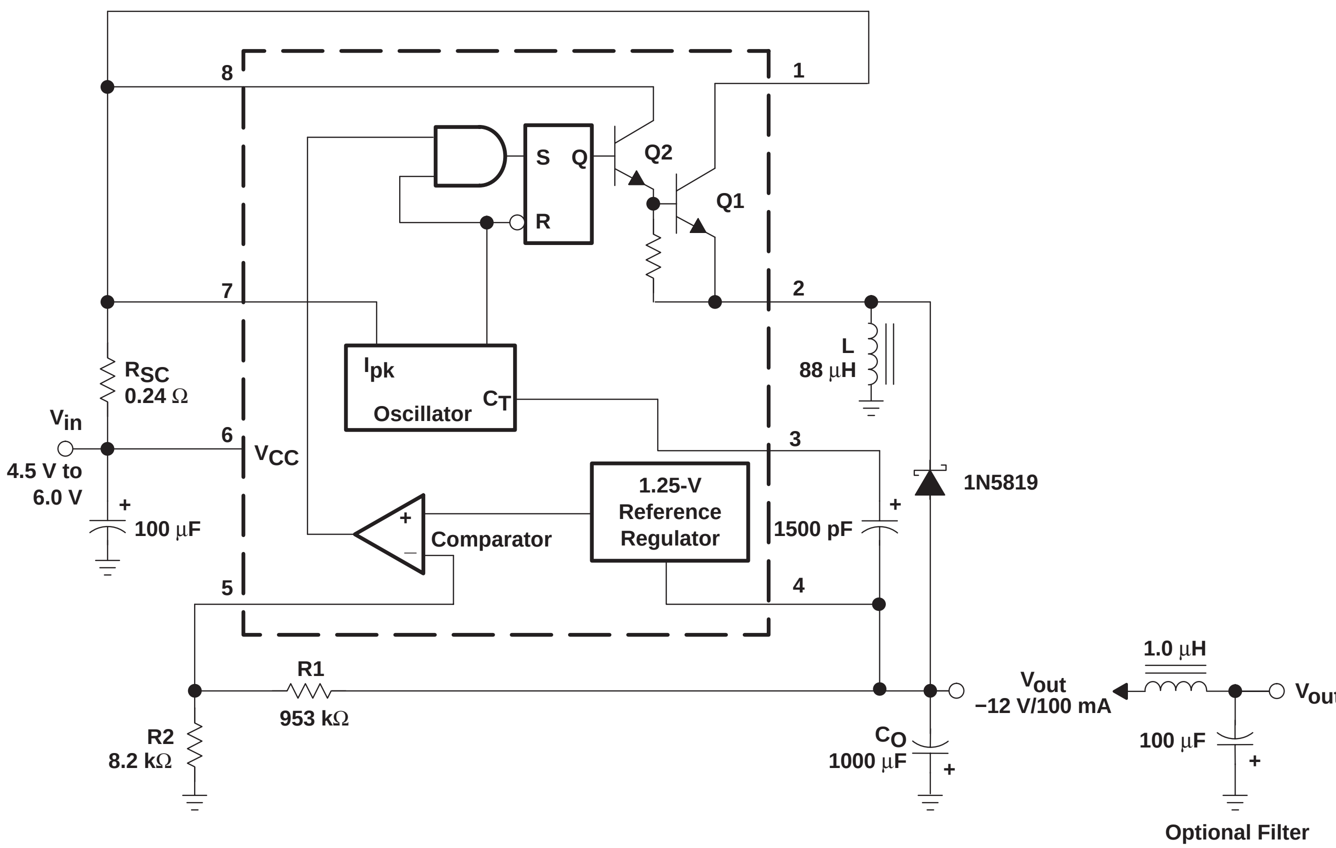


Figure 4. External Current Boost Connections for I_C Peak Greater Than 1.5 A

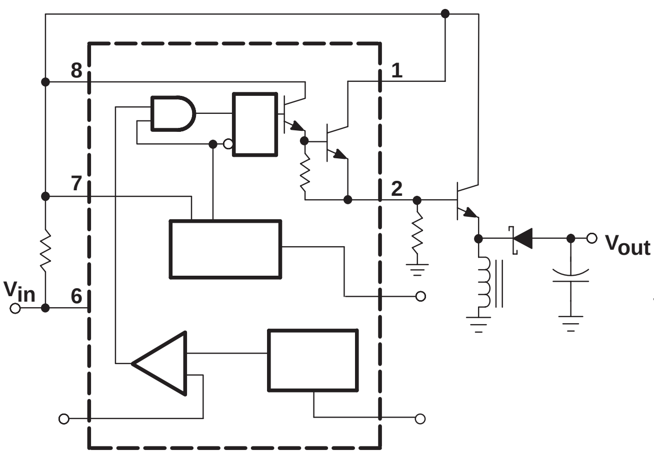
TYPICAL CHARACTERISTICS



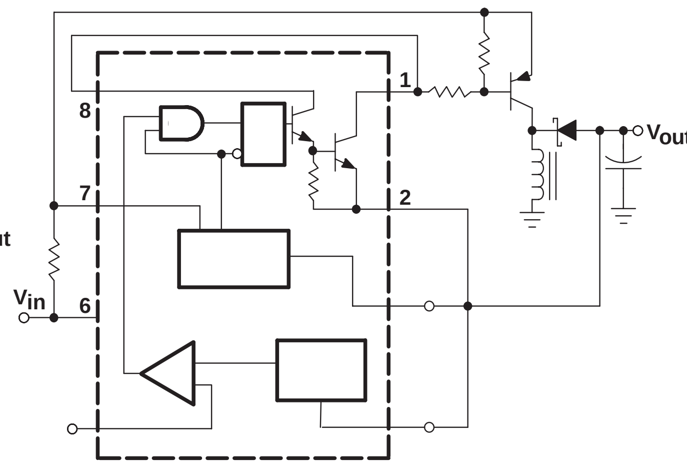
TEST	CONDITIONS	RESULTS
Line Regulation	V_{IN} = 4.5 V to 6 V, I_O = 100 mA	3 mV = ±0.12%
Load Regulation	V_{IN} = 5 V, I_O = 10 mA to 100 mA	0.022 V = ±0.09%
Output Ripple	V_{IN} = 5 V, I_O = 100 mA	500 mV_{PP}
Short-Circuit Current	V_{IN} = 5 V, R_L = 0.1 Ω	910 mA
Efficiency	V_{IN} = 5 V, I_O = 100 mA	62.2%
Output Ripple With Optional Filter	V_{IN} = 5 V, I_O = 100 mA	70 mV_{PP}

Figure 5. Voltage Inverting Converter

TYPICAL CHARACTERISTICS



6a. External npn Switch



6b. External pnp Saturated Switch

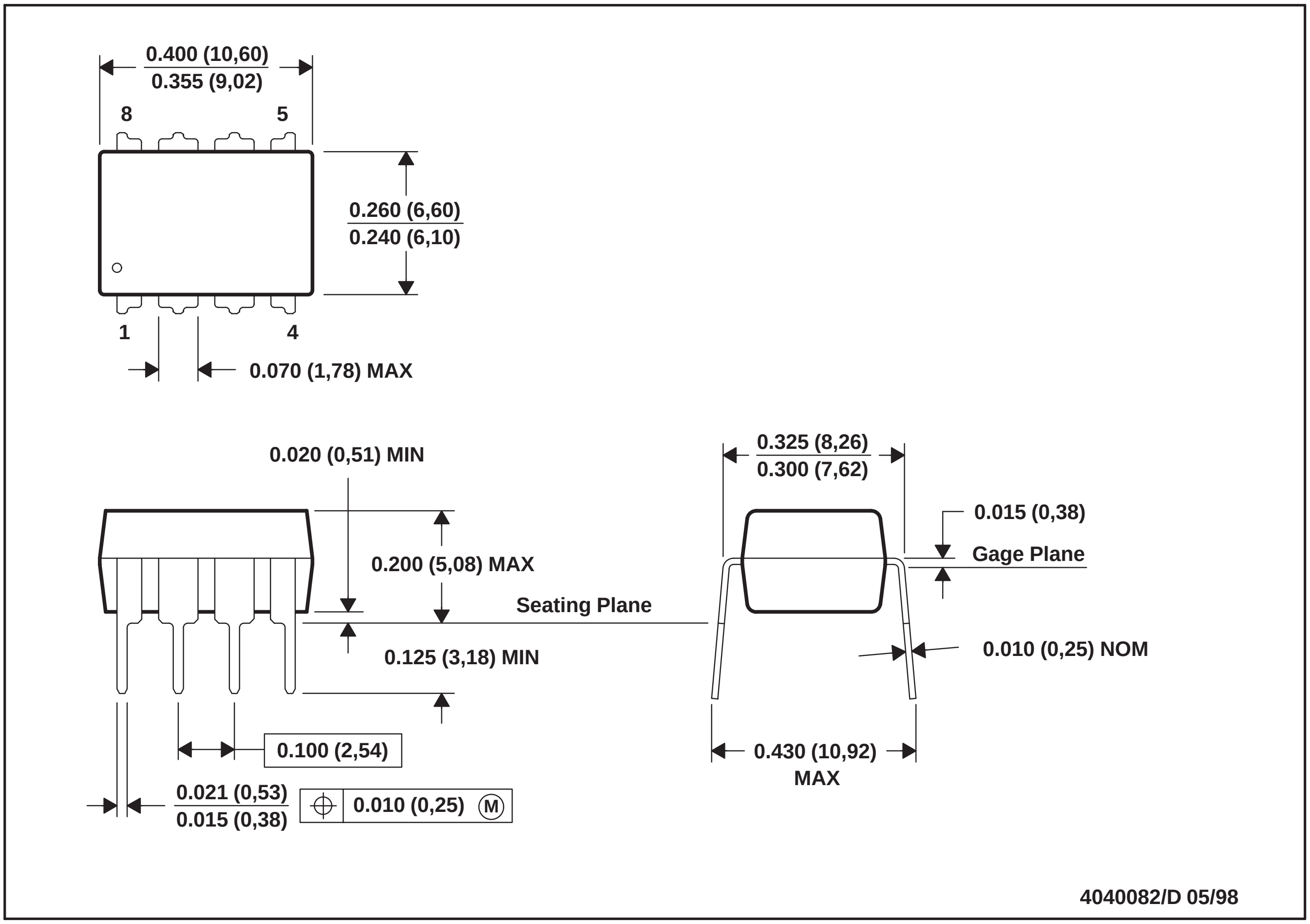
Figure 6. External Current Boost Connections for I_C Peak Greater Than 1.5 A

APPLICATION INFORMATION

calculations of key parameters

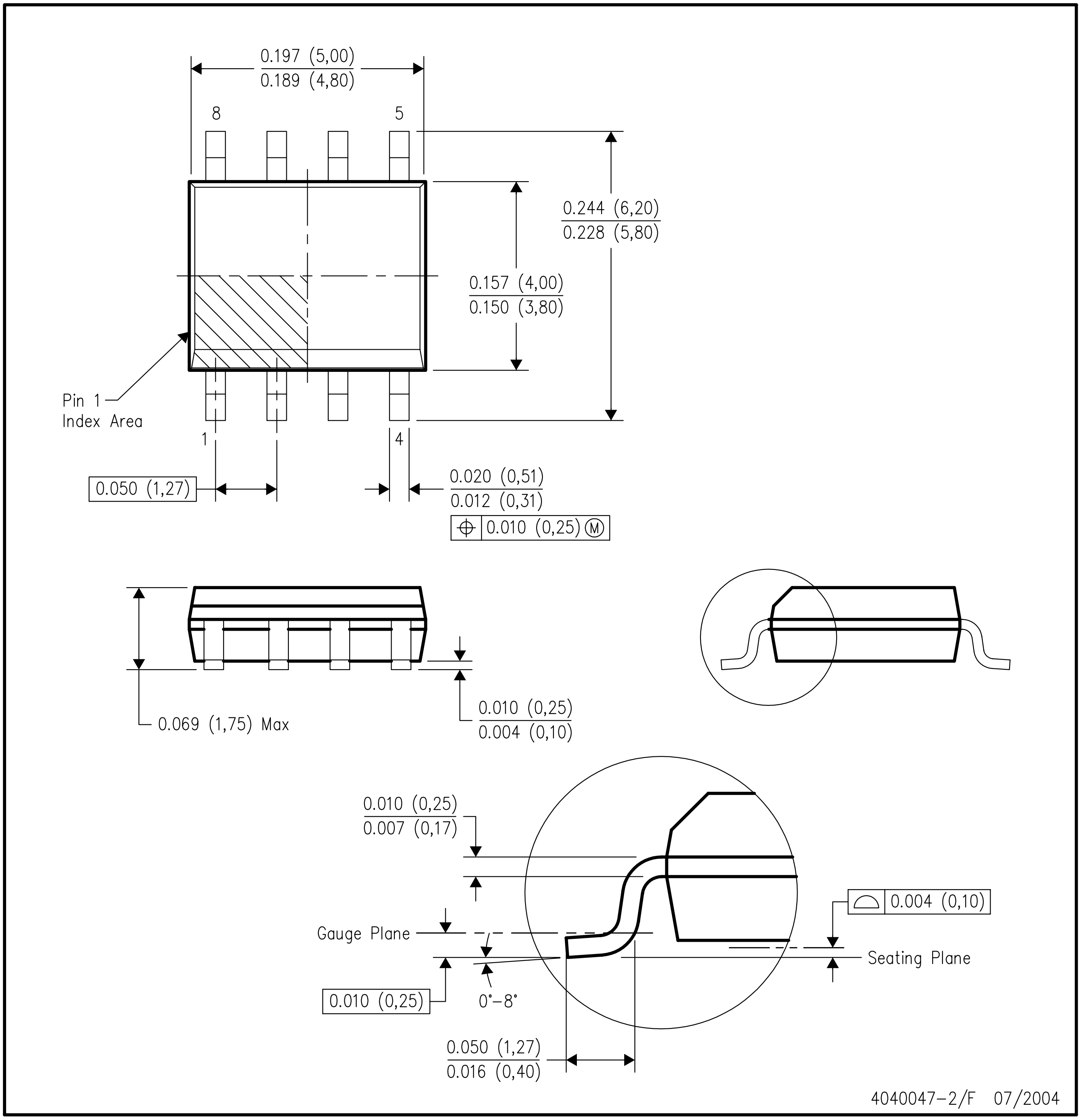
CALCULATION	STEP UP	STEP DOWN	VOLTAGE INVERTING
t_{on}/t_{off}	$\frac{V_{out} + V_F = V_{in(min)}}{V_{in(min)} - V_{sat}}$	$\frac{V_{out} + V_F}{V_{in(min)} - V_{sat} - V_{out}}$	$\frac{\lvert V_{out}\rvert + V_F}{V_{in} - V_{sat}}$
$(t_{on} + t_{off})$	$\frac{1}{f}$	$\frac{1}{f}$	$\frac{1}{f}$
t_{off}	$\frac{t_{on} + t_{off}}{\frac{t_{on}}{t_{off}} + 1}$	$\frac{t_{on} + t_{off}}{\frac{t_{on}}{t_{off}} + 1}$	$\frac{t_{on} + t_{off}}{\frac{t_{on}}{t_{off}} + 1}$
t_{on}	$(t_{on} + t_{off}) - t_{off}$	$(t_{on} + t_{off}) - t_{off}$	$(t_{on} + t_{off}) - t_{off}$
C_T	$4.0 \times 10^{-5}\ t_{on}$	$4.0 \times 10^{-5}\ t_{on}$	$4.0 \times 10^{-5}\ t_{on}$
$I_{pk(switch)}$	$2I_{out(max)}\left(\frac{t_{on}}{t_{off}} + 1\right)$	$2I_{out(max)}$	$2I_{out(max)}\left(\frac{t_{on}}{t_{off}} + 1\right)$
R_{SC}	$\frac{0.3}{I_{pk(switch)}}$	$\frac{0.3}{I_{pk(switch)}}$	$\frac{0.3}{I_{pk(switch)}}$
$L_{(min)}$	$\left(\frac{(V_{in(min)} - V_{sat})}{I_{pk(switch)}}\right)t_{on(max)}$	$\left(\frac{(V_{in(min)} - V_{sat} - V_{out})}{I_{pk(switch)}}\right)t_{on(max)}$	$\left(\frac{(V_{in(min)} - V_{sat})}{I_{pk(switch)}}\right)t_{on(max)}$
C_O	$g\ \frac{I_{out}t_{on}}{V_{ripple(pp)}}$	$\frac{I_{pk(switch)}(t_{on} + t_{off})}{8V_{ripple(pp)}}$	$g\ \frac{I_{out}t_{on}}{V_{ripple(pp)}}$

P (R-PDIP-T8) **PLASTIC DUAL-IN-LINE**



NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-001

D (R–PDSO–G8) PLASTIC SMALL–OUTLINE PACKAGE



NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS–012 variation AA.

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